# An Update on NOAA Operational Precipitation Products and NOAA's Contributions to the PMM Science Team

**Pingping Xie[1] and Ralph Ferraro[2]**

*[1]NOAA/NWS/NCEP/CPC, [2]NOAA/NESDIS/STAR*

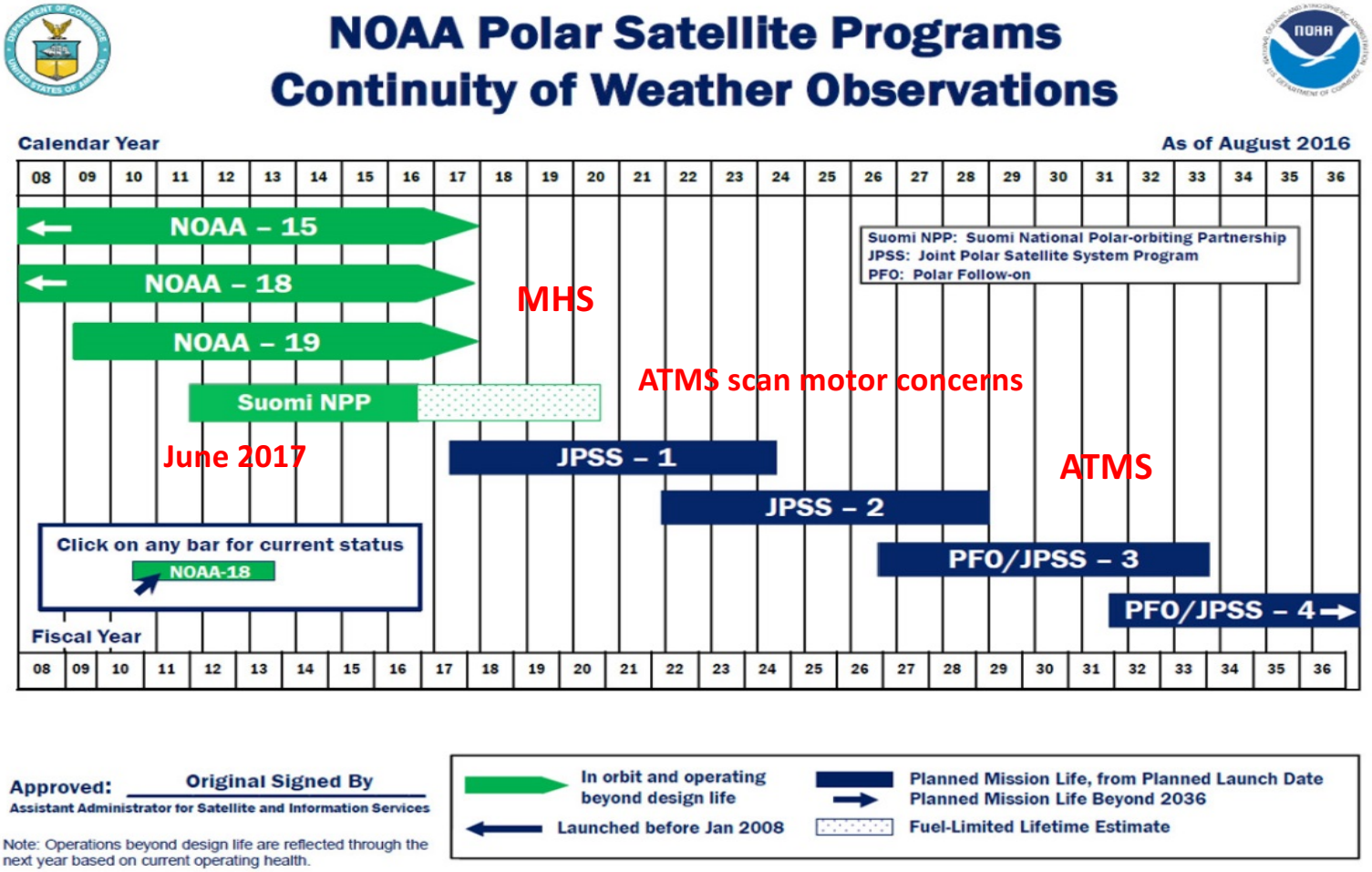
*College Park, MD*

*Includes contributions by other PI's on the NOAA PMM Science Team*

# Outline

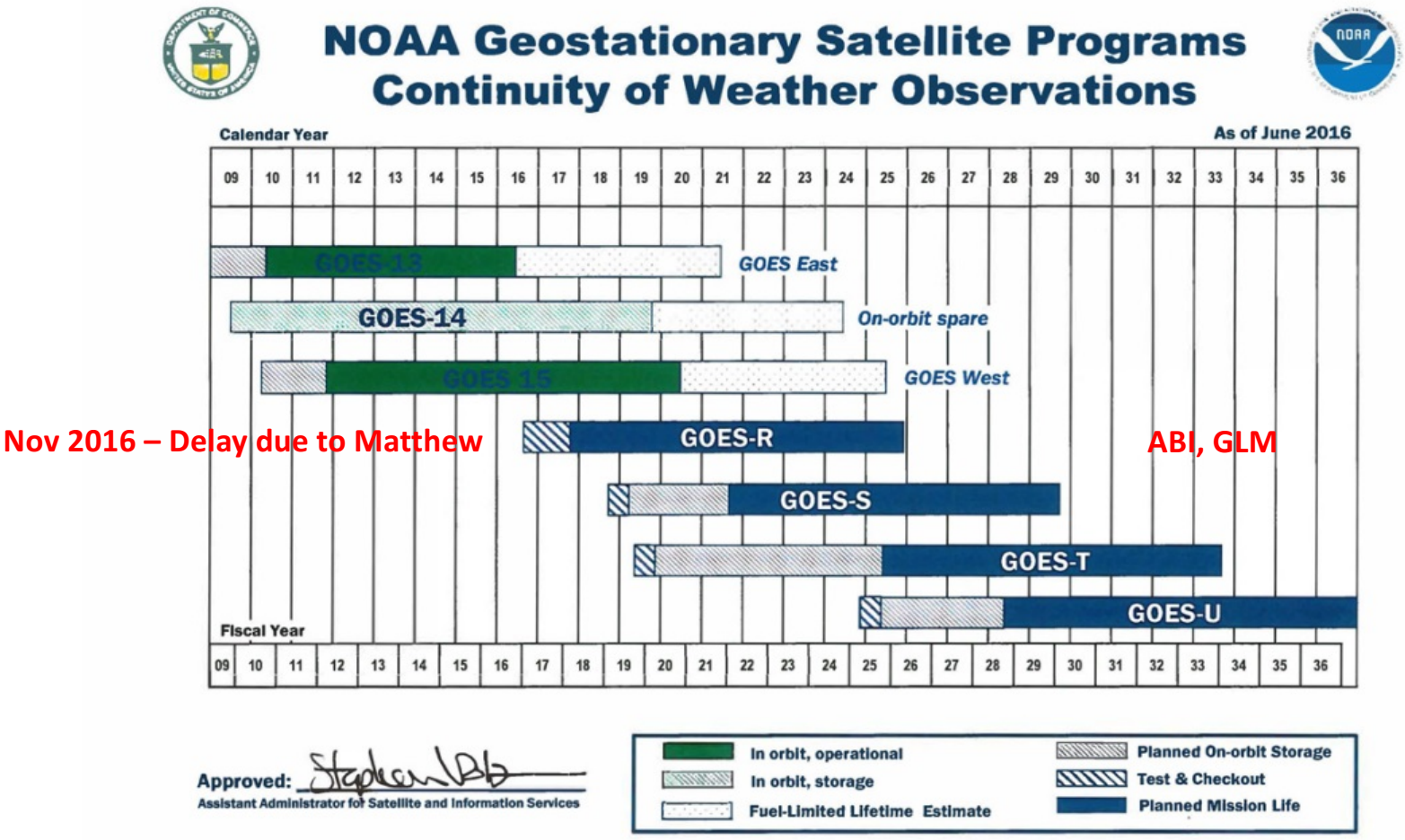
- Status of NOAA Satellites and of Operational NOAA Precipitation Products
- NOAA Use of GPM data and products
- NOAA/NWS/Office of Water Prediction
- NOAA activities related to PMM Science Team

# LEO Satellites




**We also exploit MetOp-A, B and DMSP F-17 and F-18**

# GEO Satellites



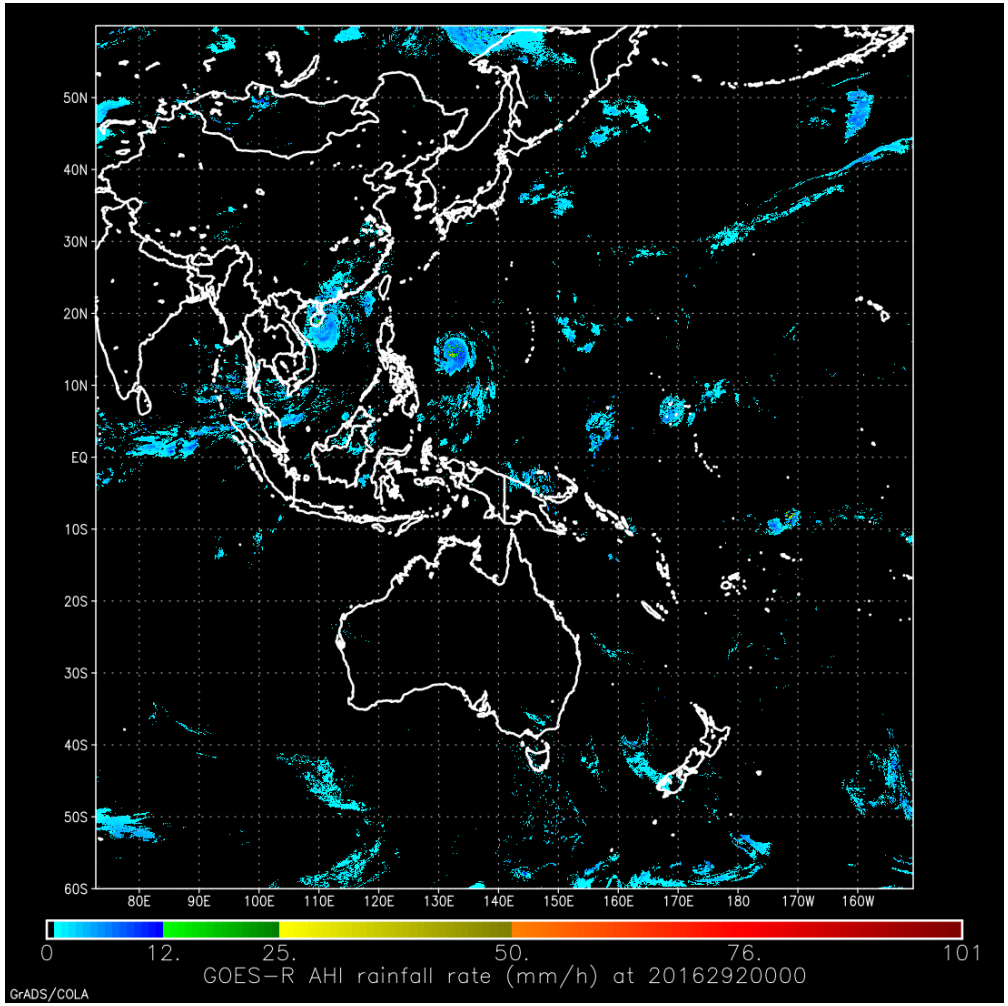

Nov 2016 – Delay due to Matthew

ABI, GLM

# Pre-Launch Evaluation of the GOES-R Rainfall Rate Algorithm

Robert J. Kuligowski, Yaping Li, and Yan Hao

- An IR-based, MW-calibrated (including GPM) rain rate algorithm with latency <4.5 min
- Fills a critical gap for short-fuse operational forecasting applications
- Running in real time in Himawari-8 data for algorithm evaluation prior to GOES-R launch

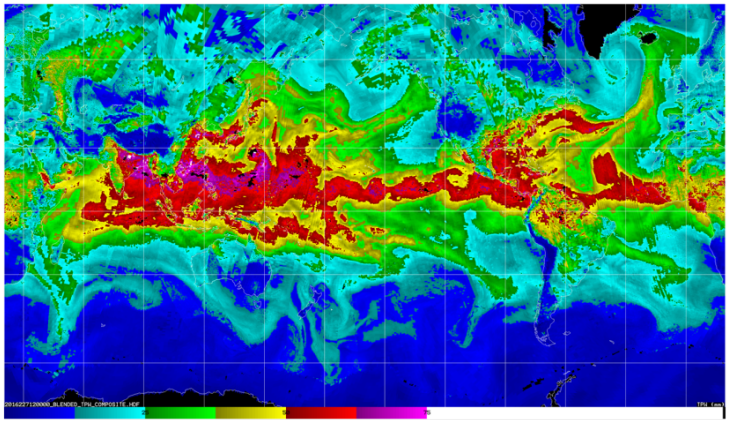


# NESDIS Status - GPM/GMI

- NASA PPS --> NESDIS DDS data feed established in Jan 20, 2015
- GPM/GMI Data and Products in HDF5 have been made to NOAA and its partner users – Feb 2015
  - NWS through NCO
  - DoD through DAPE, including FNMOC, NAVO, the 557th Weather Wings
  - NESDIS Operational applications, including blended-hydro products, eTRAP, SMOPS, etc.
- Tailored GPM McIDAS products – Nov 2015
  - NESDIS SAB
  - NWS NAWIPS, including NHC
- Tailored GPM BUFR products – Jun 2016
  - JCSDA
  - NCEP
  - EMC
- Experimental MiRS GPM products – Aug 2016
- Blended-Hydro Products with GPM data – Scheduled for Nov 2016

**Blended TPW with MIRS GPM Data**

12 hours beginning 12Z 14 August 2016



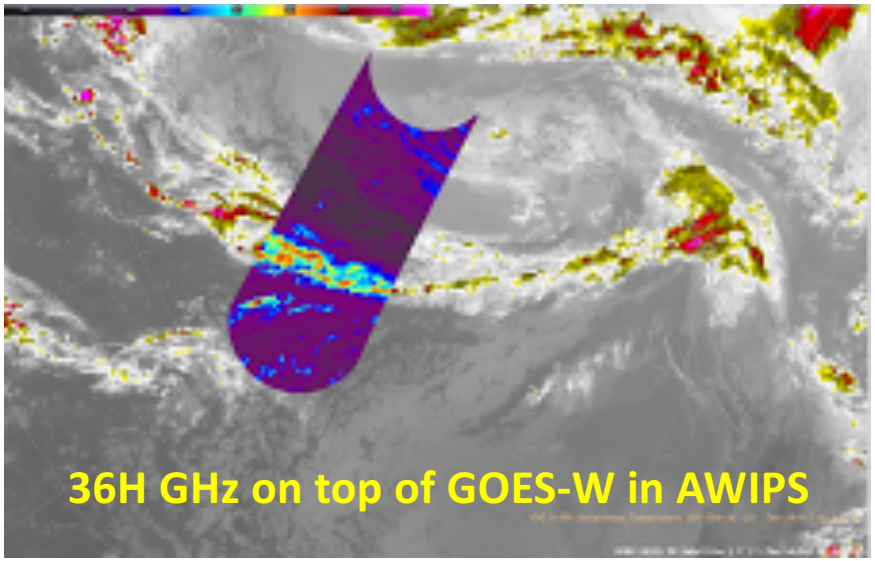
# S-NPP/JPSS-1/ATMS

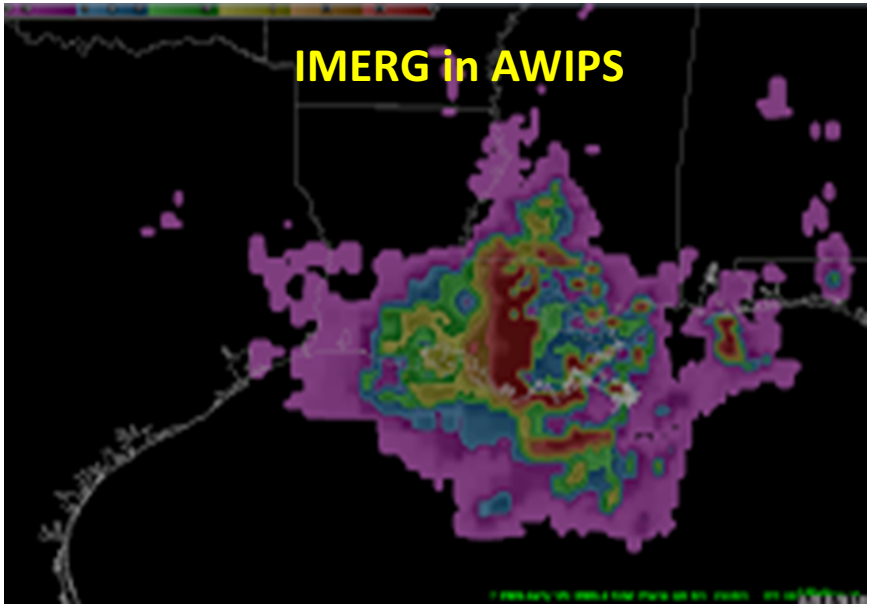
- S-NPP ATMS products are available in operation, and made to NOAA and its partner users, including NASA PPS
  - ATMS RDRs – Jan 2014
  - MiRS products – Feb 2014
  - Blended-Hydro products with S-NPP data – Sept 2015

- JPSS-1 readiness preparation is essentially completed – Jun 2017 launch
- The operational implementation of MiRS high resolution products from NOAA-18, -19, Metop-A, F17, F18 has been further delayed - Dec 2016
- MSPPS retirement is now being pushed to 2017 due to the delay of the operational readiness of MiRS high resolution products – May 2017

# NWS GPM Product Deployment Status

- NWS is currently integrating specific GPM products into our Forecaster Warning Decision Workstations for use in operational tropical (e.g. hurricanes) and flood forecasting
- Specific software plug-ins built and are being operationally evaluated in the Advanced Weather Interactive Processing System (AWIPS)
- Products currently being evaluated include 36 and 89 GHZ imagery, & IMERG Early Rain Rate Products
- IMERG Late Products to be evaluated for use in 2017



# GMI Data Assimilation Update (JCSDA)

- Optimization of clear-sky GMI data assimilation in the NOAA GDAS:
  - Added capability to spatially average GMI observations
  - Made modifications to GMI quality control (bug fix in graupel retrieval, addition of latitude filter)
- New 4D EnsVar impact experiments completed; forecast/analysis impacts being assessed
- Effort wrapped up to assimilate GMI in clear-sky conditions
  - Manuscript to be submitted for peer review is forthcoming
- GMI up for consideration for inclusion (at least assimilated in monitor mode) in next operational upgrade
  - Dependent on status of operational BUFR stream and 4D experiment results
- Possibility of all-sky GMI data assimilation effort beginning at JCSDA?

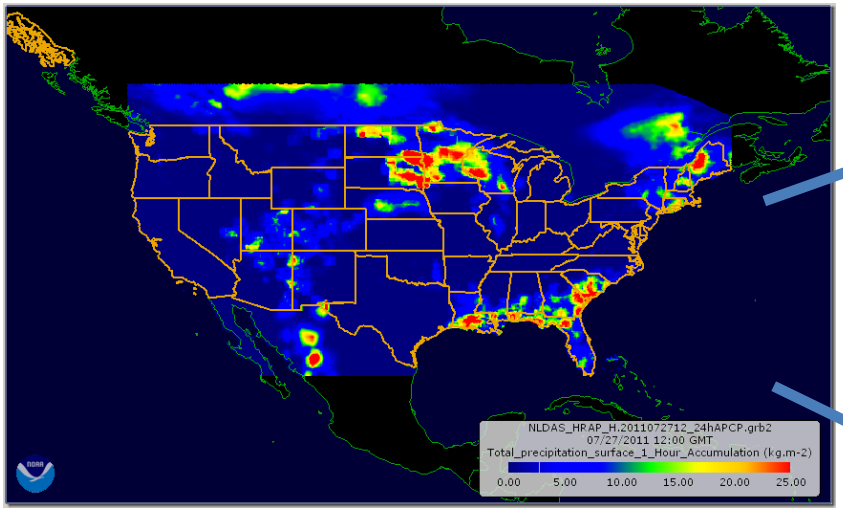
# NWS/Office of Water Prediction

- Office of Water Prediction was reorganized from National Water Center (Tuscaloosa, AL) and Office of Hydrologic Development (Silver Spring, MD) in June 2016 (http://water.noaa.gov/)

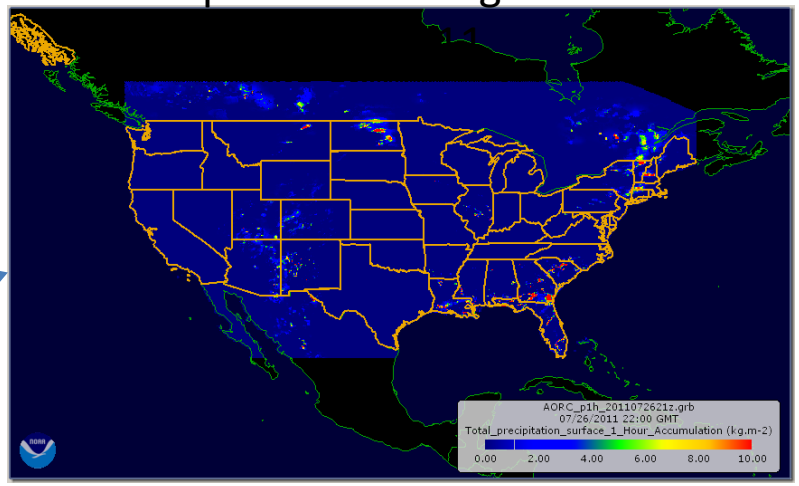
- Provides science and software support for NWS hydrologic analysis and prediction functions
- Operates National Water Model in collaboration with NCEP
- Applications of PMM data:
  - Expansion of Analysis of Record for Calibration (AORC)
  - Potentially in National Water Model forcings suite

# Application of CMORPH in AORC

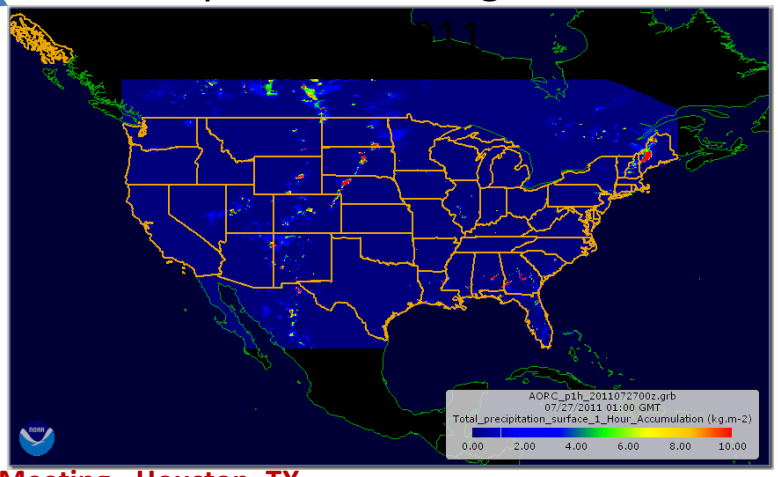
24h Precipitation Ending
1200 UTC 27 Jul 2011
(CPC/NLDAS2)




1h Precipitation Ending 2100 UTC 26




1h Precipitation Ending 0000 UTC 27




- 24-h gauge based total is disaggregated to hourly with 1-h radar, satellite, and gauge- based hourly totals;
- Similar to NLDAS2 historic and real-time;
- AORC will continue to use CMORPH, which in turn contains PMM inputs

# NOAA Projects for PMM

*Nine subtasks submitted as a single, no-cost to NASA, proposal*

- **Contributions to the GPM GV Activities and Process Studies**
  - Characterization of Orographic Precipitation During IPHEX and HMT-SEPS (R. Cifelli)
  - Development of a ground radar-based snow database for satellite algorithms (J.J. Gourley)

- **Contributions to the Improvements of GPM Level 1, 2 and 3 Products**

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  - Algorithm Enhancement for GPM Constellation Radiometers to Support NOAA/NWS Regions (R. Ferraro)
  - Enhancement of NOAA Operational Snowfall Rate (SFR) Product for GPM Constellation Satellites (H. Meng)

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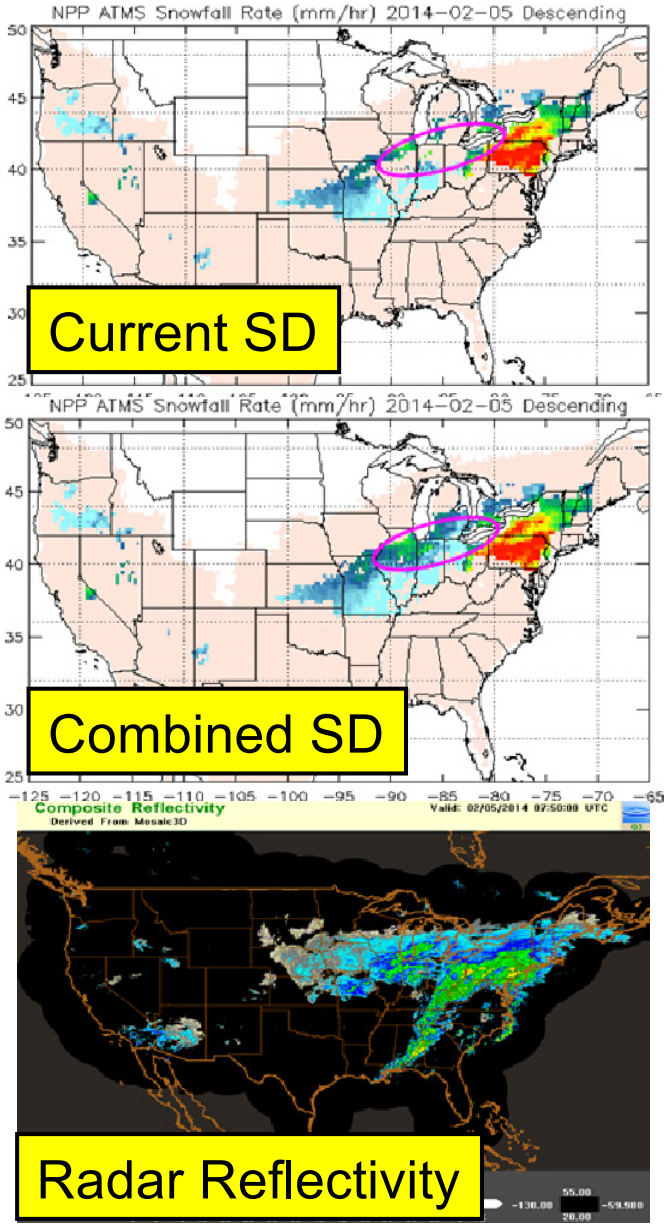
  - Development of 2nd generation pole-to-pole CMORPH (P. Xie and Joyce)
  - Enhancing regional CMORPH with gauge, radar and model data (P. Xie)

- **Improving NOAA Operations and Climate Data Records with GPM Data**
  - A Rainfall Nowcaster Based on Multisensor Data (R. Kuligowski)
  - Development and Transition of Precipitation Climate Data Records (B. Nelson)
  - Changes in the hydrological cycle in the extratropics using GPM data (P. Groisman)

# Enhancement of NOAA Operational Snowfall Rate Product for GPM Constellation Satellites

Huan Meng, Ralph Ferraro, Jun Dong, Cezar Kongoli, Limin Zhao, Banghua Yan, Nai-Yu Wang, Bradley Zavodsky

- SFR is produced from ATMS and AMSU/MHS from five satellites at near real-time
- Improvement to snowfall detection (SD) for shallow snowfall: Optimally combining a satellite-based shallow snowfall SD and a model-based SD model; the combined SD also improves thick-cloud snowfall.
- Improvement to snowfall rate: Adding liquid water effect to RTM; developing more robust initialization method for cloud properties.
- Product assessment at NWS Weather Forecast Offices (WFOs): active participation from forecasters from six WFOs; feedback indicated usefulness of SFR especially in radar void regions; issues with precip phase and performance degradation in Alaska.



# Precipitation CDR

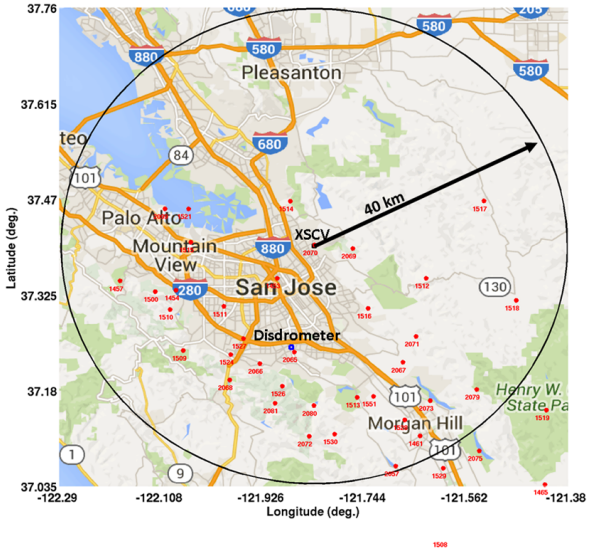
## *Brian Nelson NOAA/NCEI*

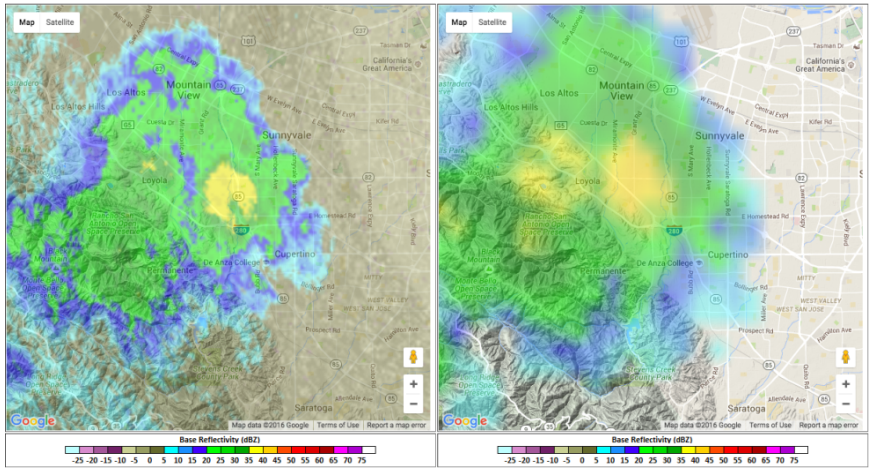
- **PERSIANN – CDR (Operational REDR 2014) (UC-Irvine Sorooshian)**
  - 0.25 x 0.25 degree (60N-60S, 0-360)
  - Daily
  - 1983-present
  - Updated quarterly
- **AMSU CDRs for Hydrologic Applications (Transition to Operational FY2016) (NOAA – Ferrarro)**
  - 2.5 degree and 1 degree (90N-90S, 0-360)
  - Monthly, Pentad, Daily
  - 1979-present and 1997-present
- **CPC Morphing (Transition to Operational FY2017) (NOAA - Xie)**
  - 0.25 x 0.25 degree (60N-60S, 0-360)
  - 3-hourly and Daily
  - 1998-present
- **Global Precipitation Climatology Project (Transition to Operational FY2016/17) (UMD – Adler)**
  - 2.5 degree and 1 degree (90N-90S, 0-360)
  - Monthly, Pentad, Daily
  - 1979-present and 1997-present
- **NEXRAD Reanalysis (Transition to Operational FY2017) (NOAA – Nelson)**
  - 1km CONUS
  - 5-minute
  - 2002-2011

# Performance of Gap-Fill Radar for QPE in San Francisco Bay Area

*R. Cifelli NOAA/OAR/ESRL/PSD*

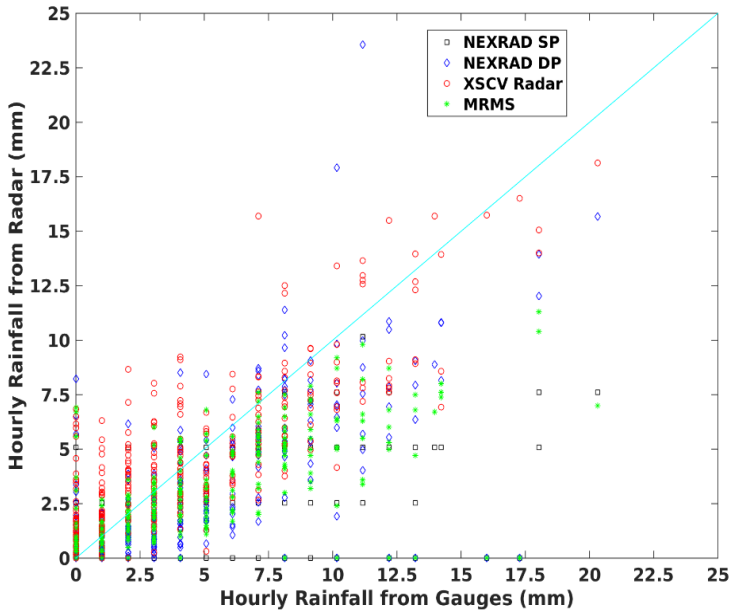
- **X-band radar in Santa Clara, CA**
  - **Feb-May 2016**
  - **Support Super bowl during El Niño**
  - **Part of NOAA El Nino Rapid Response Campaign (ENRR)**
  - **Prototype for larger Bay Area project**

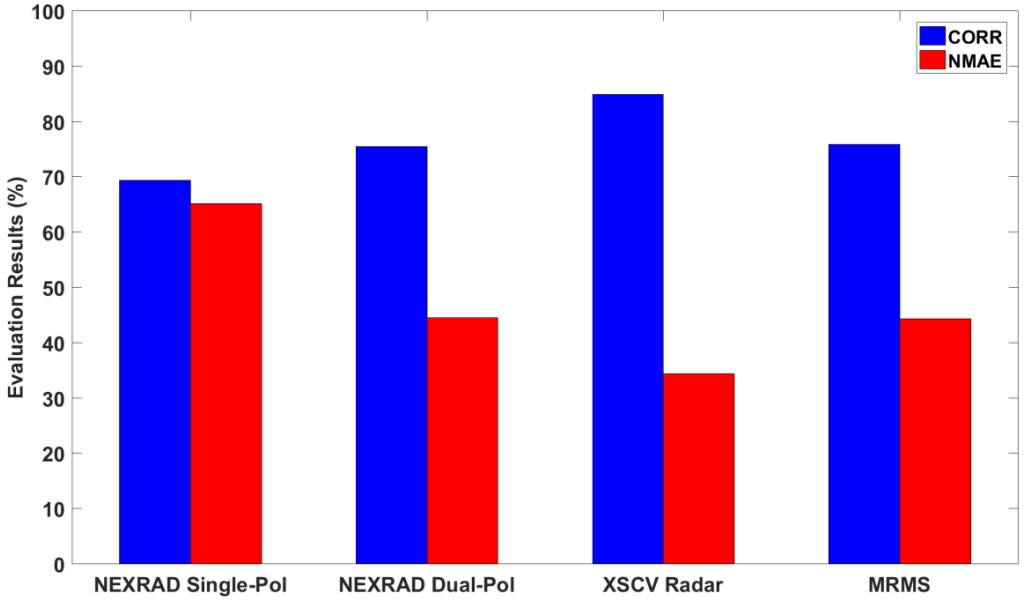


# Radar Rainfall Evaluation

Comparison of hourly rainfall products:
Santa Clara X-band radar vs. NEXRAD Level 3 products vs. MRMS radar-only vs. rain gauges



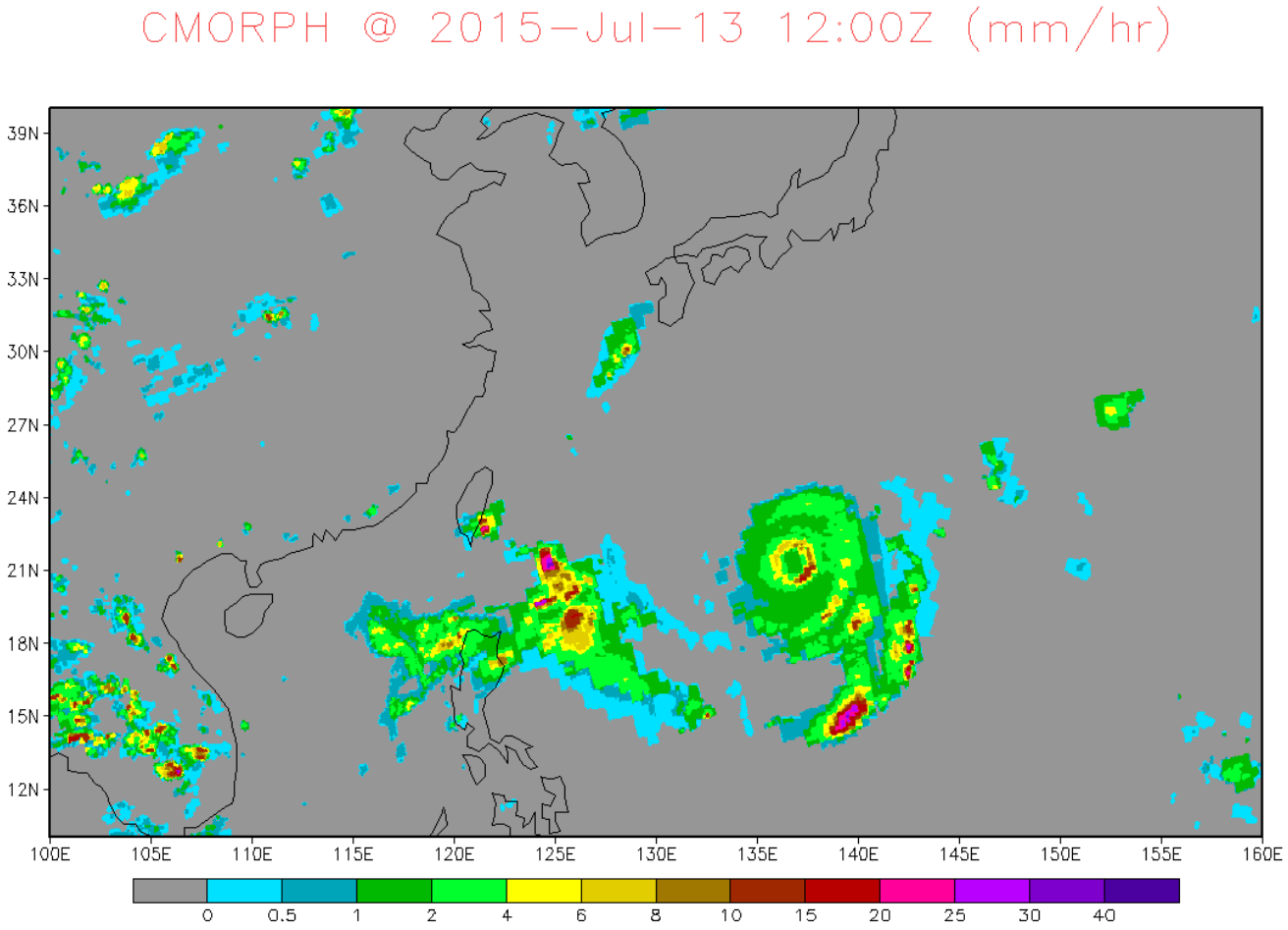

- X-Band has highest correlation and lowest error

# Second Generation CMORPH

- **Features**
  - **0.05°lat/lon over the globe pole to pole**
  - **15-min interval generated at reduced latency**
  - **Explicit representation of snowfall rate**

- **Algorithm Developments**
  - **AVHRR IRTB based precipitation estimates through calibration against MWCOMB and CloudSat**
  - **Refined precipitating cloud motion vectors combining vectors from CFS reanalysis and IR precipitation estimates**
  - **Inclusion of snowfall rate retrievals from NESDIS/STAR (Huan Meng)**

# Second Generation CMORPH




- With motion vectors defined on a much finer resolution (0.25°lat/lon), the rotational component of the precipitation movements is much better captured.

# Summary

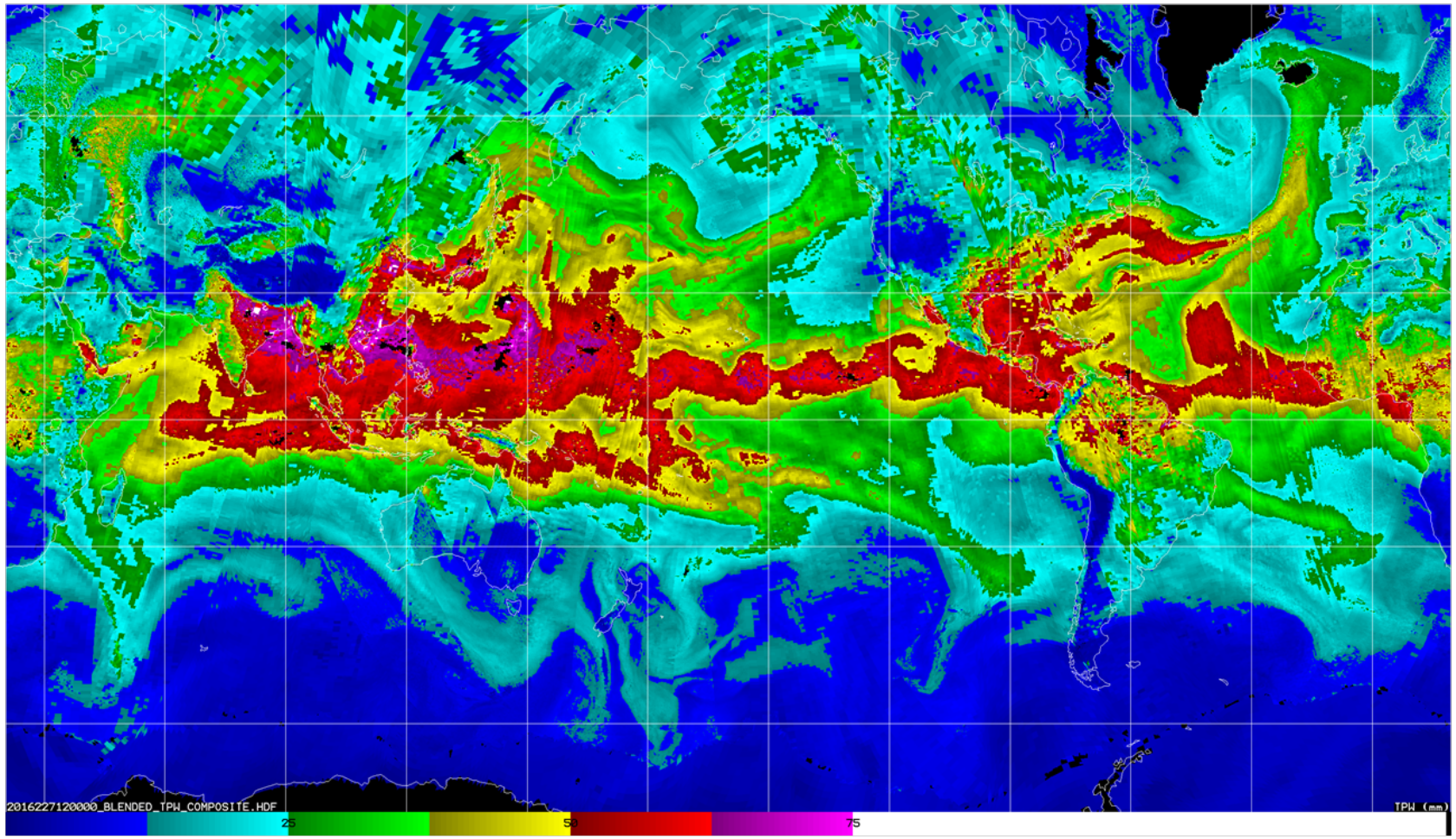
- **JPSS / GOES-R satellites preparation / launch basically on schedule --- carrying sensors measuring precipitation and related variables**

- **GPM products being fed of NOAA operational data flows**

- **GPM related research, development and applications programs undergoing at NOAA (no-cost proposal)**

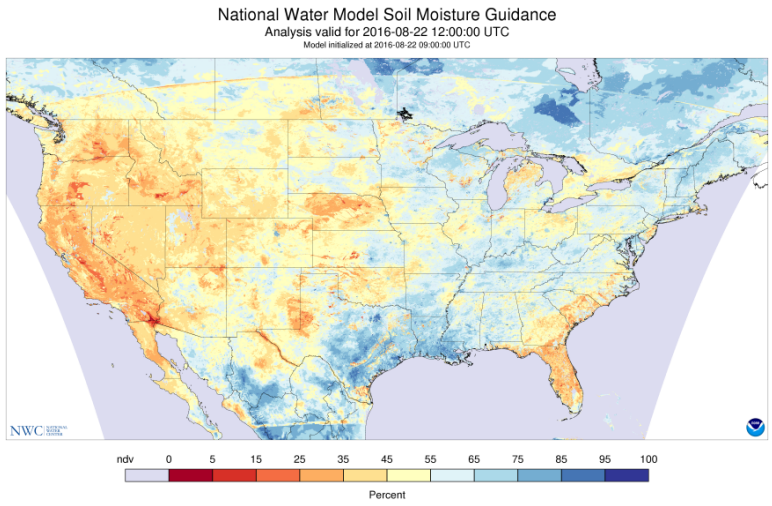
# Blended TPW with MIRS GPM Data

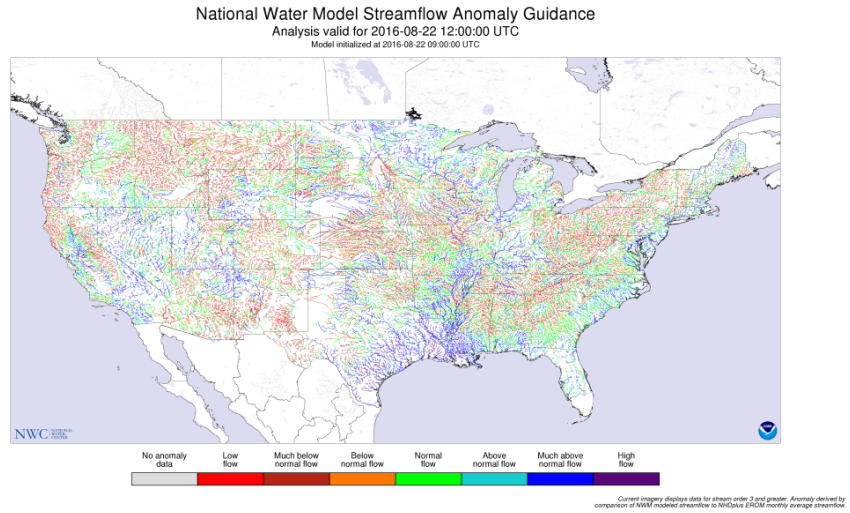
12 hours beginning 12Z 14 August 2016



# National Water Model

- **Operational since August 16, 2016**
- **Based on WRF-Hydro framework**
- **Hourly updates to soil, streamflow analyses**
- **Hourly-to-daily updates of forecasts**
- **Antecedent precipitation presently estimated from:**
  - **MRMS radar and gauge/radar analyses**
  - **Rapid Refresh and High-Resolution Rapid Refresh short-range model forecasts**
- **NWM long-term plans include satellite precipitation inputs**




http://water.noaa.gov/about/nwm

# NESDIS - GCOM-W1/AMSR-2

- NASA PPS --> NESDIS DDS data feed established in Apr 6, 2015
- GCOM/AMSR-2 Data and Products in netCDF4 have made available to NOAA and its partner users – Dec 2015
  - NWS Centers through NCO
  - DoD users through DAPE – FNMOC, NAVO, the 557th Weather Wings
  - NESDIS Operational applications, including blended-hydro products, eTRAP, etc.
- Tailored GCOM McIDAS products – Nov 2015
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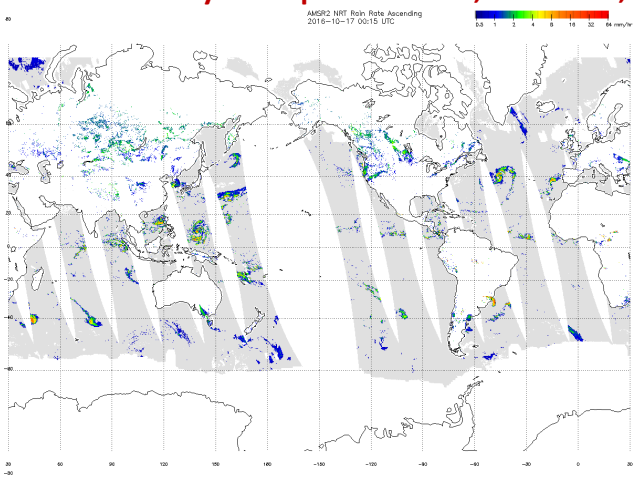

- Blended-Hydro Products with GCOM data – Mar 2016
- Day-2 products, including soil moisture, snow cover, etc. – Oct 2016

# NESDIS - M-T/SAPHIR

- EUEMSAT -> NESDIS DDS data feed established – Dec 4, 2014
- Operational Decision Briefing to SPSRB – Oct 21, 2015
- M-T/SAPHIR L1B data in BUFR will made available to users – Dec 2015
  - NCEP
  - EMC
- NOAA unique products with MiRS (TPW and RR only) – Dec 2015
  - NRL
  - NESDIS SAB